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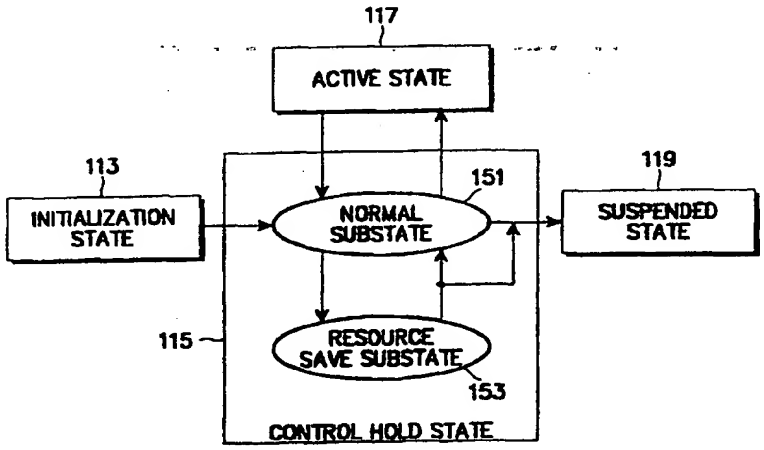

(57) Abstract

A method for increasing a channel efficiency and saving a transmission power by controlling outputs of a dedicated control channel and a pilot channel when data transmission is discontinued temporarily during the data communication in a mobile communication system. The mobile communication system includes an active state (117) in which user data is transmitted through a dedicated traffic channel and a control message is transmitted through a dedicated control channel when there exists information to transmit. A base station of the mobile communication system comprises the steps of transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated control channel, when there is no data to transmit for a first set time in the active state; and transitioning to a second control hold state for logically connecting the dedicated control channel to control an output of a transmission signal, when there is no data to transmit for a second set time in the first control hold state. Here, the data to transmit is user data and control data. Further, the logical connection in the second control hold state discontinues, in a state where the channel resource is logically assigned, a transmission output of a corresponding channel.

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DATA COMMUNICATION METHOD IN MOBILE COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a data communication method in a CDMA mobile communication system, and in particular, to a method for reducing battery power consumption of mobile station while having no user traffic to transmit and just maintaining dedicated control channel.

2. Description of the Related Art

At present, CDMA (Code Division Multiple Access) mobile communication systems operate in accordance with the IS-95 standard, which supports a voice service only. In the near future, mobile communications will be performed according to an IMT-2000 (International Mobile Telecommunication-2000) standard which supports a high speed packet data service as well as the voice service. The IMT-2000 standard aims at multimedia services such as a high quality voice service, a moving picture service, an internet search service, etc. In the CDMA mobile communication system, communication links between a terminal (i.e, mobile station) and a base station are widely divided into a forward link from the base station to the terminal and a reverse link from the terminal to the base station.

During a packet data communication, the mobile communication system

transmits data in a spot and has a relatively long and frequent standstill where the data is not transmitted by the traffic pattern of packet data. Accordingly, for the future mobile communication system, there has been proposed a technique for connecting the channels only when the data is transmitted during the packet data communication. That is, taking into consideration the limited radio resources, the base station air capacity and the battery power of the mobile terminal, it is necessary to connect a dedicated traffic channel only while the data is transmitted, release the traffic channels for other mobile stations while the data is not transmitted, and quickly reconnect the traffic channels when the user data appears.

However, to reassign the traffic channel in order to restart transmitting the data after stoppage of the data transmission, channel re-negotiation should be made between the base station and the terminal. This re-negotiation procedure may result in additional signaling overhead and latency. Here, the overhead includes control messages necessary for synchronization of a radio link protocol (RLP), and control messages necessary for the service negotiation made during the reconnection of the data service.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method for increasing a utilization efficiency of channel resources by connecting and releasing the channels according to presence/absence of traffic data to be transmitted during a packet data communication in a mobile communication system.

It is another object of the present invention to provide a method for increasing a channel efficiency and saving a terminal transmission power by

controlling outputs of a dedicated control channel and a pilot channel when data transmission is discontinued temporarily during the data communication in a mobile communication system.

According to one aspect of the present invention, a data communication method in a base station of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel and a control message is transmitted through a dedicated control channel when there exists information to transmit, the method comprising the steps of transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated control channel, when there is no data to transmit for a first set time in the active state; and transitioning to a second control hold state for logically connecting the dedicated control channel to control an output of a transmission signal, when there is no data to transmit for a second set time in the first control hold state. Here, the data to transmit is user data and control data. Further, the logical connection in the second control hold state discontinues, in a state where the channel resource is logically assigned, a physical transmission output of a corresponding channel.

According to anther aspect of the present invention, a data communication method in a terminal of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel, a control message is transmitted through a dedicated control channel when there exists information to transmit, and a pilot signal is transmitted through a reverse pilot channel, the method comprising the steps of transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated traffic channel and the reverse pilot channel; and transitioning to a second control hold

state for logically connecting the dedicated control channel and the reverse pilot channel to control an output of a transmission signal in order to save a transmission power.

According to still another aspect of the present invention, a data communication method in a mobile communication system including an active state, in which a base station transmits, to a terminal, traffic data through a forward dedicated traffic channel and control data through a forward dedicated control channel when there exists information to transmit, in which the terminal transmits, to the base station, traffic data through a reverse dedicated traffic channel, control data through a reverse dedicated control channel when there exists information to transmit, and power control information for a forward link through a reverse pilot channel, the method comprising the steps of, if there is no data to transmit for a first set time in the active state, transitioning to a first control hold state where the base station releases the dedicated traffic channel and notifies this situation to the terminal, and the terminal releases the reverse dedicated traffic channel under the control of the base station; if there is no data to transmit for a second set time in the first control hold state, transitioning to the second control hold state where the base station connects the forward dedicated control channel and notifies this situation to the terminal, and the terminal maintains the dedicated control channel and the reverse pilot channel to control a transmission output under the control of the base station.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in

conjunction with the accompanying drawings in which like reference numerals indicate like parts. In the drawings:

FIG. 1 is a state transition diagram for a data service in a mobile communication system;

FIG. 2 is a state transition diagram for explaining a control hold state in a mobile communication system according to an embodiment of the present invention;

FIG. 3 is a flowchart illustrating a method for determining an initial output value of a forward dedicated control channel in a resource save substate of a control hold state according to an embodiment of the present invention;

FIG. 4 is a flowchart for explaining a transition to an active state after a call setup and a transition from the active state to the control hold state in a mobile communication system according to an embodiment of the present invention; and

FIG. 5 is a flowchart for explaining a transition from the active state to the control hold state and a transition from the control hold state to a suspended state in a mobile communication system according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described hereinbelow with reference to the accompanying drawings.

In order to provide an effective data communication, a mobile communication system requires new channels in addition to the conventional channels and should have new states for performing the data communication using the new channels. For the convenience of explanation, the channels used in the

embodiment and the states occurring during the data communication service will be first defined hereinbelow.

In the specification, a term "connection" refers to logical and physical connections, and a term "logical connection" refers to a state where an assigned channel is logically connected but a transmission output is physically restricted to reduce a power consumption. Further, a term "traffic data" means user data and a term "control data" includes a control message and a signaling message communicated through a dedicated control channel. In addition, "data" includes the control data and the traffic data.

First, the relationship between the logical channels and the physical channels is shown in Table 1.

TABLE 1

	Forward Link		Reverse Link	
	Logical CH	Physical CH	Logical CH	Physical CH
Initialization State	PPCH	Paging CH	PACH	Access CH
Control Hold State	DMCH DSCH	Dedicated Control CH	DMCH DSCH	Dedicated Control CH
Active State	DMCH DSCH DTCH	Dedicated Control CH	DMCH DSCH DTCH	Dedicated Control CH

	DTCH	Supplemental CH	DTCH	Supplemental CH
Suspended State	PMCH	Paging CH	PMCH	Packet Access CH
Dormant State	PPCH	Paging CH	PACH	Access CH

Now, a brief description will be made as to the logical channels designed to be suitable for a state transition model newly defined in Table 1.

A packet paging channel (PPCH) is a forward channel through which the base station transfers a layer 3 signaling message and a medium access control (MAC) message. The PPCH is called PDPCH in the dormant state and PSPCH in the suspended state. A packet access channel (PACH) is a channel used at the terminal to transmit the layer 3 signaling message and the medium access control message. This channel is shared by the mobile terminals through an access mechanism based on competition. The packet access channel is called PDACH in the dormant state and PSACH in the suspended state. A dedicated MAC channel (DMCH) is a bi-directional channel necessary for transmission of the medium access control message. This channel is a one-to-one channel assigned in the control hold state and the active state for the packet service. A dedicated signaling channel (DSCH) is a channel necessary for transmission of the layer 3 signaling message. This channel is a one-to-one channel assigned in the control hold state and the active state for the packet service. A dedicated traffic channel (DTCH) is a channel necessary for transmission of the user data. This channel is a one-to-one channel assigned in the active state for the packet service. A common traffic channel

(CTCH) is a forward or reverse channel for transmitting instantaneous short data in a dormant/idle substate of the dormant state. This logical channel is a one-to-one channel assigned during a short data transmission interval.

In the mobile communication system, the forward link and the reverse link include the following channels to provide the data communication service.

First, as shown in Table 1, the forward link includes the common control channel, the dedicated traffic channel, the dedicated control channel, the paging channel and the pilot channel. The pilot channel is used for synchronization between the terminal and the base station or for power control of the terminal. Through this channel, all the terminals can receive a pilot signal that the base station transmits. The paging channel is used when the base station searches for a specific terminal. However, since all the terminals receive a signal on this channel, a message requires an identification field for discrimination of the terminals. Therefore, the paging channel is not suitable for transmission of mass data. To transmit the mass data, the dedicated control channel and the dedicated traffic channel are assigned to the respective terminals. The dedicated traffic channel is used in transmitting the user packet data, and the dedicated control channel is used in transmitting the control message and the signaling message. These dedicated channels are synchronized with the pilot channel and operates in a DTX (Discrete Transmit) mode where the data can be transmitted only when needed. The output of the pilot channel is always maintained so that the synchronization may not be lost. The discrete transmit mode enables an effective use of the overall output from the base station by preventing the unnecessary data output.

Next, as shown in Table 1, the reverse link includes the common access

channel, the packet access channel, the dedicated traffic channel, the dedicated control channel and the dedicated pilot channel. The common access channel and the packet access channel are shared by several terminals and used in transmitting the control signal necessary for assignment of the dedicated channels. The dedicated traffic channel and the dedicated control channel are used in the same way as those in the forward link. The reverse dedicated pilot channel is a channel for transmitting a pilot signal and power control information to the base station, and each terminal is assigned with a unique dedicated pilot channel. This is because a pilot synchronization of one terminal cannot be used by another terminal since the respective terminals have different positions.

The data is transmitted using the above stated channels, and the terminal and the base station operate according to a state transition diagram show in FIG. 1.

Referring to FIG. 1, a packet null state 111 is a state where the power is turned on, waiting for a data service-related request to be received. When a packet data service request is received from an exterior in this packet null state 111, transition to an initialization state 113 takes place.

In the initialization state 113, the forward and reverse dedicated control channel are established for the data transmission. Here, the established dedicated control channel can be used by the corresponding terminal only. After establishment of the dedicated control channel, the initialization state transitions to a control hold state 115.

In the control hold state 115, the dedicated traffic channel are established to transmit the data, if any. After the data transmission, the control hold state 115

transitions to an active state 117. In the active state 117, the traffic data and the control data are transmitted using the dedicated traffic channel and the dedicated control channel, respectively. If there is no data for a time $T_{\_Active}$ set in a timer in the active state 117, transition occurs from the active state 117 back to the control hold state 115. In this case, the dedicated traffic channel is released. If the data is not generated for a time $T_{\_Hold}$ set in a timer even in the control hold state 115, the dedicated control channel is released and thereafter, the control hold state 115 transitions to a suspended state 119. Here, the timers may be included in the base station and/or the terminal. In the embodiment, it is assumed that the timers are included in the base station only. As a result, the base station controls the state transition using the timers and the terminal is subjected to the state transition under the control of the base station.

In the suspended state 119, the dedicated control channel and the dedicated traffic channel which are unique channels assigned to the respective terminals, are all released. In this state, the communication between the base station and the mobile station is performed over common channels which are shared by the several terminals.

Here, in the control hold state 115, the dedicated control channel and the pilot channel are maintained bidirectionally, so that the control channel is connected even though there is no actual data to transmitted in order to immediately transmit a control signal when needed. For the forward link from the base station to the terminal, the base station has no restriction of the power consumption, so that the base station does not have the power consumption problem. However, for the reverse link from the terminal to the base station, since the data is transmitted by the terminal which uses a battery, the permissible power consumption is limited.

Accordingly, it is very important to reduce the power consumption of the terminal in the mobile communication system.

Therefore, the suspended state 119 is used to save the various resources including the transmission power by releasing the dedicated channels. However, in the suspended state 119, it takes a long time to reassign the control channel, decreasing a data transmission efficiency. Accordingly, the control hold state 115 according to the present invention includes substates for solving the transmission efficiency decrease problem in the suspended state 119. Specifically, the control hold state 115 includes a normal substate 151 and a resource save substate 153, as illustrated in FIG. 2.

The normal substate 151 is a state where the dedicated control channel is connected but the dedicated traffic channel is not connected. In this state, control information according to the state transition can be transmitted and received. Here, if a set time $T_{\_Normal}$ has elapsed without transmission of the control signal or the data in the normal substate 151, the base station notifies this situation to the terminal and then enters the resource save substate 153. However, if the data to be transmitted is generated or the control signal is received from the terminal within the set time $T_{\_Normal}$, the base station notifies this situation to the terminal, establishes the dedicated traffic channel and then transitions back to the active state 117.

The resource save substate 153 logically connects the dedicated control channel and the reverse pilot channel. Here, an output of the reverse pilot channel and forward power control bits are "0". So, the power control bits which was being transmitted through the forward dedicated control channel and the reverse pilot

signal which was being transmitted through the reverse pilot channel are not transmitted, thereby releasing a close loop power control between the base station and the terminal. Since the reverse pilot channel signal is not transmitted, the reverse dedicated control channel which was maintaining the synchronization using the reverse pilot channel signal cannot also transmit the control message. However, the dedicated control channel using the discrete transmission mode, needs to be synchronized with the pilot channel. In the resource save substate 153, if the user data to be transmitted or the control data is not generated for a set time $T_{\_Save}$, the base station notifies this situation to the terminal and then transitions to the suspended state 119. However, if the data to be transmitted is generated within the set time $T_{\_Save}$ in the resource save substate 153, the base station notifies this situation to the terminal and then transitions to the normal substate 151.

As for the state transition from the resource save substate 153 to the normal substate 151, the data transmission in the resource save substate 153 may be invoked at either the base station or the terminal.

In case that the data transmission is invoked at the base station, a command for transitioning the terminal from the resource save substate 153 to the normal substate 151 is transmitted through the forward dedicated control channel. However, since the forward dedicated control channel cannot be applied to the power control, the transmission power should be controlled by a proper method. The initial power of the forward dedicated control channel determines the value used in the normal substate 151. When the terminal does not respond to this value, the base station increases the transmission power and retransmits the command. This retransmission is necessary because the terminal has a mobility, i.e., because the previously used initial power may be insufficient if the terminal is distanced far

away from the base station. Through these procedures, it is possible to restore the channel, while reducing the interference with other terminals. A method for determining the initial power of the forward dedicated control channel in the resource save substate 153 is illustrated in FIG. 3.

Referring to FIG. 3, in case that transition to the resource save substate 153 takes place, the forward and reverse dedicated control channels and the reverse pilot channel are logically connected, so that the close loop power control is unavailable. Therefore, when transition to the resource save substate 153 takes place, the base station sets the initial power of the dedicated control channel to the value used in the normal substate 151, in step 311, and then outputs the channel data in step 313. Thereafter, in step 315, it is determined whether the output is proper. If the output is not proper (i.e., if there is no response from the terminal), the base station goes to step 317 to increase the output and returns to step 313. However, if it is judged that the output is proper, the routine is ended.

In case that the data transmission is invoked at the terminal, the terminal sets an output of the reverse pilot channel to the normal state. Here, the power of the reverse pilot channel is determined depending on the signal strength of the forward pilot channel. Since transmission of the reverse pilot channel can be started at any time, the base station should always wait to receive the reverse pilot channel signal that the terminal transmits in the resource save substate 153. To detect the pilot channel of the terminal, the base station should search for the pilot signal received through the reverse pilot channel for a predetermined time. This is called a search window. However, when the terminal turns on the reverse pilot channel again in the state where the reverse pilot channel is logically connected, the search time should be increased by changing the size of the search window in order to immediately

search for the pilot channel. It is possible to minimize the search time for the reverse pilot channel, using

$$\tau \propto v_{max} \cdot t_{save} \quad ....(1)$$

where τ is a search time, v_{max} is a maximum moving velocity of the terminal and t_{save} is a resource save substate maintaining time.

Upon acquisition of the reverse pilot channel, the base station sends a control message informing the acquisition of the pilot channel through the forward dedicated control channel. In addition, the base station generates a power control bit based on the signal strength of the restored reverse pilot channel and sends the generated power control bit through the forward dedicated control channel. With use of this information, the terminal then can determine the power control bit to be sent through the reverse link. By performing the above procedures, the control channels logically connected in the resource save substate 153 are all restored, transitioning to the normal substate 151. At this moment, the time T_{Normal} is reset by driving the timer and the state variable is also changed to the normal state.

As to the procedure in which the terminal transitions from the resource save substate 153 to the suspended state 119, this transition can take place at either the terminal or the base station. When the state transition takes place at the terminal, the terminal restores the reverse dedicated control channel in the same manner as the case where the data to be transmitted is generated, to transition to the normal substate 151, transmits a message informing the base station that the terminal will transition to the suspended state 119 through the dedicated control channel, and then transitions to the suspended state 119. When the transition takes place at the

base station, the base station sends a message informing that the state transition is required, to the terminal through the forward dedicated control channel now in operation. Upon reception of this message, the terminal then releases the dedicated control channel in the resource save substate 153 and directly transitions to the suspended state 119.

When the state transition takes place from the suspended state 119 to the control hold state 115, the normal substate 151 is selected without passing the resource save substate 153 in order to reduce the time required in establishing the dedicated control channel. However, when transitioning from the resource save substate 153 to the suspended state 119, the terminal transitions to the normal substate 151 and then transitions to the suspended state 119.

FIG. 4 is a flowchart illustrating the procedure that the base station connects the forward and reverse dedicated control channels during initialization, and then transmits the data.

Referring to FIG. 4, upon reception of a data transmission request through the paging channel or the access channel in the initialization state 113, the base station establishes the dedicated control channel and transitions to the normal substate 151 of the control hold state 115, in step 411. In the normal substate 151, if the data to be transmitted is generated or transmission control data is received through the dedicated control channel, the base station notifies this situation to the terminal, establishes the dedicated traffic channel and then transitions to the active state 117, in step 413. In the active state, if the dedicated traffic channel and the dedicated control channel are connected, the base station performs the data communication function for the time $T_{\_Active}$ through the dedicated traffic channel

and exchanges the control message and the signaling message through the dedicated control channel. Here, the time $T_{\_Active}$ is a first reference time necessary for the transition from the active state 117 to the normal substate 151. Accordingly, the base station maintains the active state 117, if the data is transmitted within the time $T_{\_Active}$. The time $T_{\_Active}$ is initialized to restart, when the data is generated.

However, if discontinuance of data transmission continues for the time $T_{\_Active}$ in the active state 117, the base station senses it in step 415. Subsequently, in step 417, the base station notifies this situation to the terminal through the dedicated traffic channel, releases the dedicated traffic channel to connect the dedicated control channel and then transitions to the normal substate 151. At this moment, the time $T_{\_Active}$ is cleared. After transition to the normal substate 151, the base station analyzes in step 419 information on the dedicated control channel to check whether the data is generated within the time $T_{\_Normal}$. Here, the time $T_{\_Normal}$ is a second reference time necessary for the transition from the normal substate 151 to the resource save substate 153. If the data to be transmitted is generated with the time $T_{\_Normal}$, the base station senses it in step 419. Thereafter, in step 421, the base station notifies this situation to the terminal (i.e., transmits to the terminal a control message necessary for assignment of the dedicated traffic channel), establishes the dedicated traffic channel and then transitions to the active state 117.

However, if there is no data to be transmitted for the time $T_{\_Normal}$ in the normal substate 151, the base station senses it in step 419. Subsequently, in step 423, the base station notifies the terminal to maintain the logical connection of the dedicated control channel and the reverse pilot channel, discontinues outputting the transmission data and transitions to the resource save substate 153. In the resource save substate 153, the forward dedicated control channel and the reverse dedicated

control channel are logically connected, so that the output is controlled. At the moment, the dedicated control channel is also logically connected. Accordingly, since there does not exist a signal transmitted from the terminal to the base station through the reverse link, it is possible to save the power of the terminal. In addition, since the dedicated control channel is logically connected, the base station can quickly send the data when needed. At this moment, the time $T_{\_Normal}$ is cleared.

After the transition to the resource save substate 153, the base station analyzes in step 425 information on the dedicated control channel to check whether the data to be sent is generated with a time $T_{\_Save}$. Here, the time $T_{\_Save}$ is a third reference time necessary for the transition from the resource save substate 153 to the suspended state 119. When the data to be sent is generated with the time $T_{\_Save}$, the base station senses it in step 425. Subsequently, in step 427, the base station transmits to the terminal a control message necessary for establishment of the bi-directional dedicated control channels and the reverse pilot channel, and then transitions to the normal substate 151. In the normal substate 151, the base station assigns the dedicated traffic channel and transitions to the active state, in step 429.

As described above, when discontinuance of the data transmission exceeds the first reference time in the active state, the base station releases the dedicated traffic channel currently in operation, and maintains the dedicated control channel only. Accordingly, since the traffic channel is released when the traffic data is not transmitted, other users can use the traffic channel, thereby increasing the traffic channel efficiency. Moreover, since the dedicated control channel is connected, the base station can establish the new dedicated traffic channel and transition to the active state 117 as soon as the data is generated in the normal substate 151.

In addition, if the data to be transmitted is not generated for the second reference time in the normal substate 151, the base station logically connects the reverse pilot channel to control the output and transitions to the resource save substate 153 where the dedicated control channel also maintains in the logical connection state. In this case, since the terminal does not transmit the data, it is possible to save the power of the terminal. Further, since the dedicated control channel is logically connected, the base station can quickly transition to the normal substate 151 as the data is generated.

FIG. 5 is a flowchart illustrating the procedure that the base station releases the channels and then transitions to the suspended state.

In the active state, the dedicated traffic channel and the dedicated control channel are connected, and the base station performs the data communication function for the time $T_{\_Active}$ through the dedicated traffic channel and exchanges the control information through the dedicated control channel. If discontinuance of the data transmission exceeds the time $T_{\_Active}$ in the active state 117, the base station notifies this situation to the terminal through the dedicated control channel, releases the dedicated traffic channel and then transitions to the normal substate 151, in step 511. At this moment, the time $T_{\_Active}$ is cleared. After the transition to the normal substate 151, the base station analyzes information on the dedicated control channel in step 513 to check whether the data to be transmitted is generated with the time $T_{\_Normal}$.

However, if there is no data to be transmitted for the time $T_{\_Normal}$ in the normal substate 151 of the control hold state 115, the base station senses it in step 513. Subsequently, in step 515, the base station logically connects the forward and

reverse dedicated control channels and the reverse pilot channel to control the output, notifies this situation to the terminal and then transitions to the resource save substate 153. Accordingly, since the there is no signal transmitted from the terminal through the reverse link, it is possible to save the power of the terminal. Further, since the dedicated control channel is logically connected, the base station can quickly send the data when needed. At this moment, the time $T_{\_Normal}$ is cleared.

After the transition to the resource save substate 153, the base station analyzes information on the dedicated control channel in step 517 to check whether the data is generated with the time $T_{\_Save}$. Here, the time $T_{\_Save}$ is the reference time necessary for the transition from the resource save substate 153 to the suspended state 119. If the data to be sent is not generated for the time $T_{\_Save}$ in the resource save substate 153, the base station transitions to the normal substate 151 in step 519 to transmit the message necessary for the transition to the suspended state 119 to the terminal. Then, in the normal substate 151, the base station sends the suspended state transition message through the dedicated control channel and transitions to the suspended state 119 in step 529.

When the transition to the suspended state 119 takes place, the dedicated traffic channels and the reverse pilot channel assigned for the data transmission and the dedicated control channel are all released, and thereafter, if the data transmission is restarted, they are connected again. That is, if the data is generated in the suspended state 119, the base station transitions to the normal substate 151 to perform the above operation and then transitions to the active state 117.

In addition, if a high priority call occurs in the normal substate 151, the base station senses it in step 523 and directly transitions to the suspended state 119 in

step 525. Further, if the high priority call occurs even in the resource save substate 153, the base station senses it in step 527, transitions to the normal substate 151 to exchange the suspended state transition message and then transitions to the suspended state 119.

When the transition from the active state 117 to the suspended state 119 takes place, the dedicated traffic channel and the pilot channel are released in sequence according to the data transmission discontinuance time. Further, when the high priority call occurs in the normal substate 151 and the resource save substate 153, the base station immediately transitions to the suspended state 119 to service the corresponding call.

In sum, when the transition from the active state 117 to the suspended state 119 takes place, the dedicated traffic channel and the pilot channel are released in sequence according to the data transmission discontinuance time. Further, when the high priority call occurs in the normal substate 151 and the resource save substate 153, the base station immediately transitions to the suspended state 119 to service the corresponding call.

As described above, in the mobile communication system according to the present invention, the control hold state 115 is divided into the normal substate 151 and the resource save substate 153 during the data communication service. In the resource save substate 153, the dedicated pilot channel and the dedicated control channel are logically connected to control the output so that the power consumption of the terminal may be reduced. Further, as to the power control problem between the terminal and the base station which is caused by interrupt and restart of the dedicated pilot channel, the initial output values of the dedicated pilot

channel and the dedicated control channel are determined in the event that the close loop power control is impossible. In addition, it is possible to detect the reverse pilot channel in consideration of the mobility of the terminal, so that the base station can detect the state that the terminal controls on the output of the pilot channel.

As described above, the mobile communication system according to the present invention can increase the overall data transmission efficiency by dividing the control hold state into the normal substate and the resource save substate, reducing the power consumption of the terminal to the level in the suspended state and reducing the time required in establishing the dedicated traffic channel necessary for the data transmission.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A data communication method in a base station of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel and a control message is transmitted through a dedicated control channel when there exists information to transmit, said method comprising the steps of:

transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated control channel, when there is no data to transmit for a first set time in the active state; and

transitioning to a second control hold state for logically connecting the dedicated control channel to control an output of a transmission signal, when there is no data to transmit for a second set time in the first control hold state.

2. The data communication method as claimed in claim 1, wherein said data to transmit is user data and control data.

3. The data communication method as claimed in claim 1, wherein the logical connection in the second control hold state discontinues, in a state where the channel resource is logically assigned, a transmission output of a corresponding channel.

4. A data communication method in a terminal of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel, a control message is transmitted through a dedicated control channel when there exists information to transmit, and a pilot signal is transmitted through a reverse pilot channel, said method comprising the

steps of:

transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated traffic channel and the reverse pilot channel; and

transitioning to a second control hold state for controlling a transmission output of the dedicated control channel and the reverse pilot channel in order to save a transmission power.

5. The data communication method as claimed in claim 4, wherein said data to transmit is user data and control data.

6. The data communication method as claimed in claim 4, wherein the logical connection in the second control hold state discontinues, in a state where the channel resource is logically assigned, a transmission output of a corresponding channel.

7. A data communication method in a mobile communication system including an active state, in which a base station transmits, to a terminal, traffic data through a forward dedicated traffic channel and control data through a forward dedicated control channel when there exists information to transmit, in which the terminal transmits, to the base station, traffic data through a reverse dedicated traffic channel, control data through a reverse dedicated control channel when there exists information to transmit, and power control information for a forward link through a reverse pilot channel, said method comprising the steps of:

if there is no data to transmit for a first set time in the active state, the base station notifies this situation to the terminal, and the base station and the terminal release the dedicated traffic channel at a same time and then transition to a first

control hold state;

if there is no data to transmit for a second set time in the first control hold state, transitioning to a second control hold state where the base station notifies this situation to the terminal and the terminal maintains the dedicated control channel and the reverse pilot channel to control a transmission output under the control of the base station.

8. The data communication method as claimed in claim 7, wherein said data to transmit is user data and control data.

9. The data communication method as claimed in claim 7, wherein the output control step in the second hold state discontinues a transmission output of a corresponding channel.

10. A data communication method in a base station of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel and a control message is transmitted through a dedicated control channel when there exists information to transmit, the method comprising the steps of:

transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated control channel, when there is no data to transmit for a first set time in the active state;

establishing the dedicated traffic channel and transitioning to the active state, when data to transmit is generated within a second set time in the first control hold state;

transitioning to a second control hold state for logically connecting the dedicated control channel to control an output of a transmission signal, when there

is no data to transmit for the second set time in the first control hold state;

restoring a transmission output, assigning the dedicated traffic channel and transitioning to the active state, when data to transmit is generated within a third set time in the second control hold state; and

releasing the dedicated control channel and transitioning to the active state, when there is no data to transmit for the third set time in the second control hold state.

11. The data communication method as claimed in claim 10, wherein the data to transmit is user data and control data.

12. The data communication method as claimed in claim 10, wherein the transmission output control in the second hold state is to discontinue a transmission output of a corresponding channel.

13. A data communication method in a terminal of a mobile communication system including an active state in which user data is transmitted through a dedicated traffic channel, a control message is transmitted through a dedicated control channel when there exists information to transmit, and a pilot signal is transmitted through a reverse pilot channel, the method comprising the steps of:

upon reception of control data for releasing the dedicated traffic channel in the active state, transitioning to a first control hold state for releasing the dedicated traffic channel and maintaining the dedicated control channel and the reverse pilot channel;

upon reception of a message for assigning the dedicated traffic channel in the first control hold state, establishing the dedicated traffic channel and transitioning

to the active state;

upon reception of output control data in the first control hold state, transitioning to a second control hold state for maintaining the reverse dedicated control channel and the pilot channel and controlling a transmission output, so as to save a transmission power;

upon reception of control data for restart of data transmission in the second control hold state, discontinuing controlling the transmission output, establishing the dedicated traffic channel and transitioning to the active state; and

upon reception of control data for channel release in the second control hold state, releasing the reverse dedicated control channel and the reverse pilot channel and transitioning to the active state.

14. The data communication method as claimed in claim 13, wherein the output control data, received in the first control hold state, is control data that a base station generates when there is no data to transmit within a preset time, wherein the terminal discontinues a transmission output of the dedicated control channel and the pilot channel upon reception of the output control data.

15. The data communication method as claimed in claim 13, wherein the control data for channel release, received in the second control hold state, is the control data that a base station generates when there is no data to transmit for a preset time.

16. A data communication method in a mobile communication system including an active state, in which a base station transmits, to a terminal, user data through a forward dedicated traffic channel and a control message through a forward dedicated control channel when there exists information to transmit, in

which the terminal transmits, to the base station, user data through a reverse dedicated traffic channel, a control message through a reverse dedicated control channel when there exists information to transmit, and forward link power control information through a reverse pilot channel, said method comprising the steps of:

if there is no data to transmit for a first set time in the active state, the base station notifies this situation to the terminal, and the base station and the terminal release the dedicated traffic channel at a same time and transition to a first control hold state;

if data to be transmitted is generated within a second set time in the first control hold state, the base station notifies this situation to the terminal, establishes the dedicated traffic channel, and the base station and the terminal establishe the dedicated traffic channel at a same time and transition to the active state;

if there is no data to transmit for the second set time in the first control hold state, transitioning a second control hold state where the base station notifies this situation to the terminal and the terminal maintains the reverse dedicated control channel and the pilot channel and controls a transmission output so as to save a transmission power;

if data to be transmitted is generated within a third set time in the second control hold state, the base station restores a transmission output and notifies this situation to the terminal, and thereafter, the base station and the terminal assign the dedicated traffic channel at a same time and transition to the active state; and

if there is no data to transmit for the third set time in the second control hold state, the base station notifies this situation to the terminal, and then the base station and the terminal release the dedicated control channel at a same time and transition to a suspended state.

17. The data communication method as claimed in claim 16, wherein said

data to transmit is user data and control data.

18. The data communication method as claimed in claim 16, wherein the output control step in the second control hold state discontinues a transmission output of a corresponding channel.

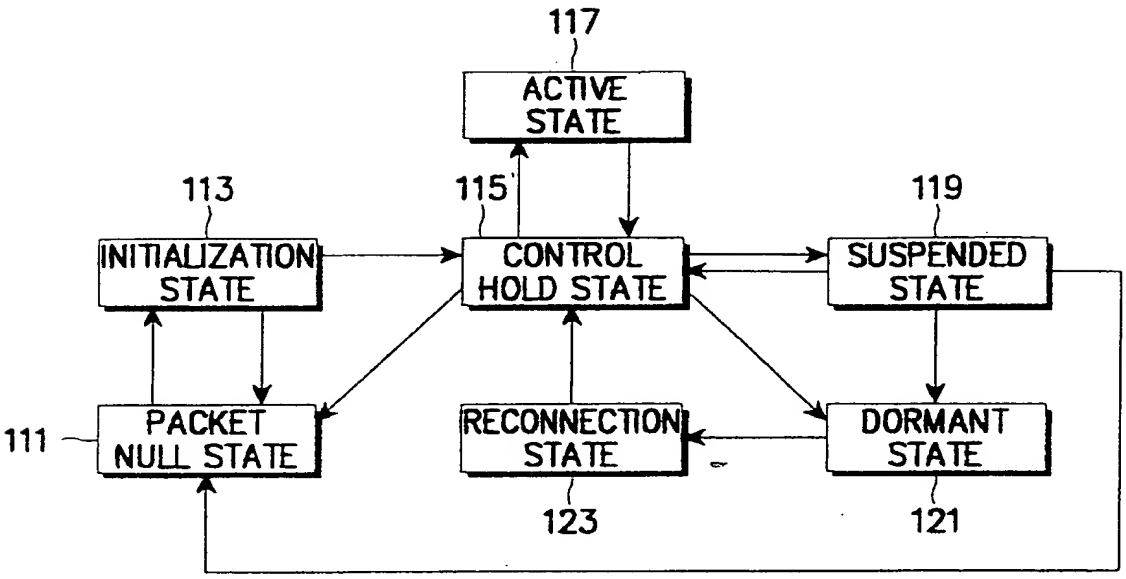
117
ACTIVE STATE
113
115
119
INITIALIZATION STATE
CONTROL HOLD STATE
SUSPENDED STATE
111
PACKET NULL STATE
RECONNECTION STATE
DORMANT STATE
123
121

FIG. 1

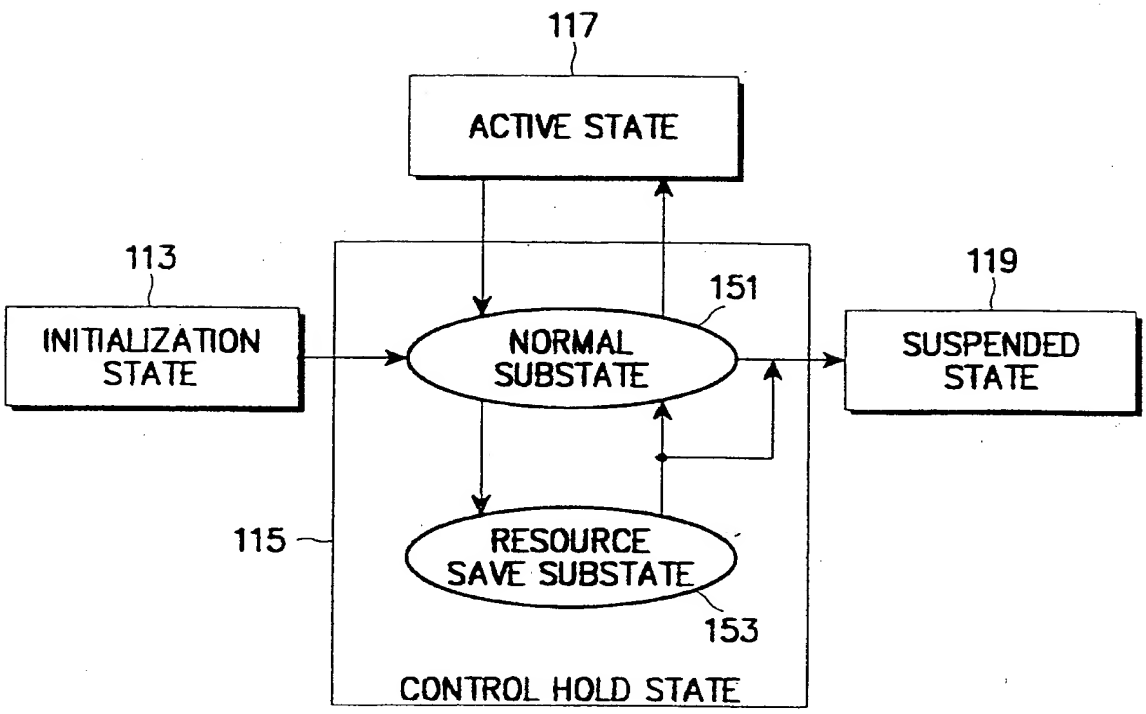
117
ACTIVE STATE
113
INITIALIZATION STATE
151
NORMAL SUBSTATE
119
SUSPENDED STATE
115
RESOURCE SAVE SUBSTATE
153
CONTROL HOLD STATE

FIG. 2

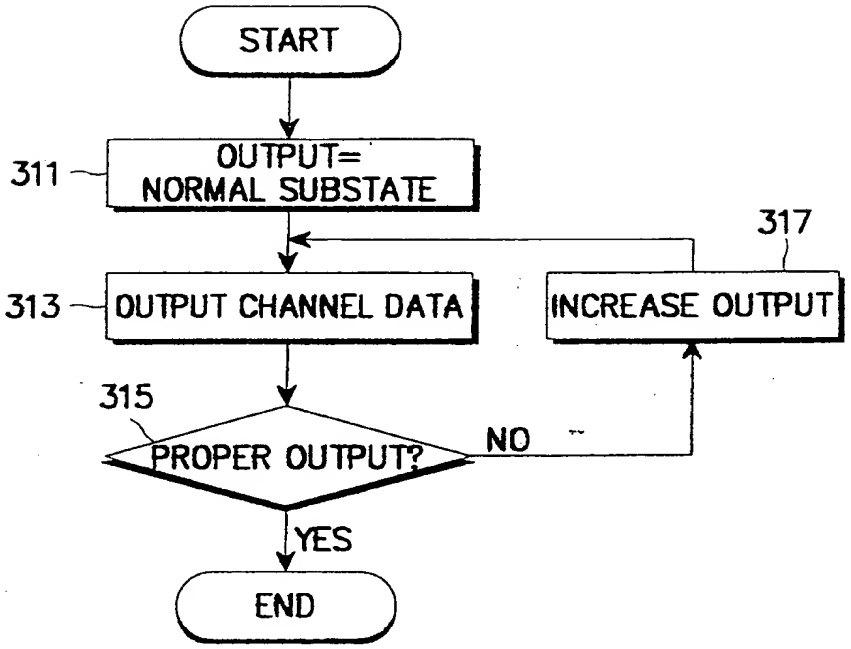
START
311
OUTPUT=
NORMAL SUBSTATE
317
313
OUTPUT CHANNEL DATA
INCREASE OUTPUT
315
PROPER OUTPUT?
NO
YES
END

FIG. 3

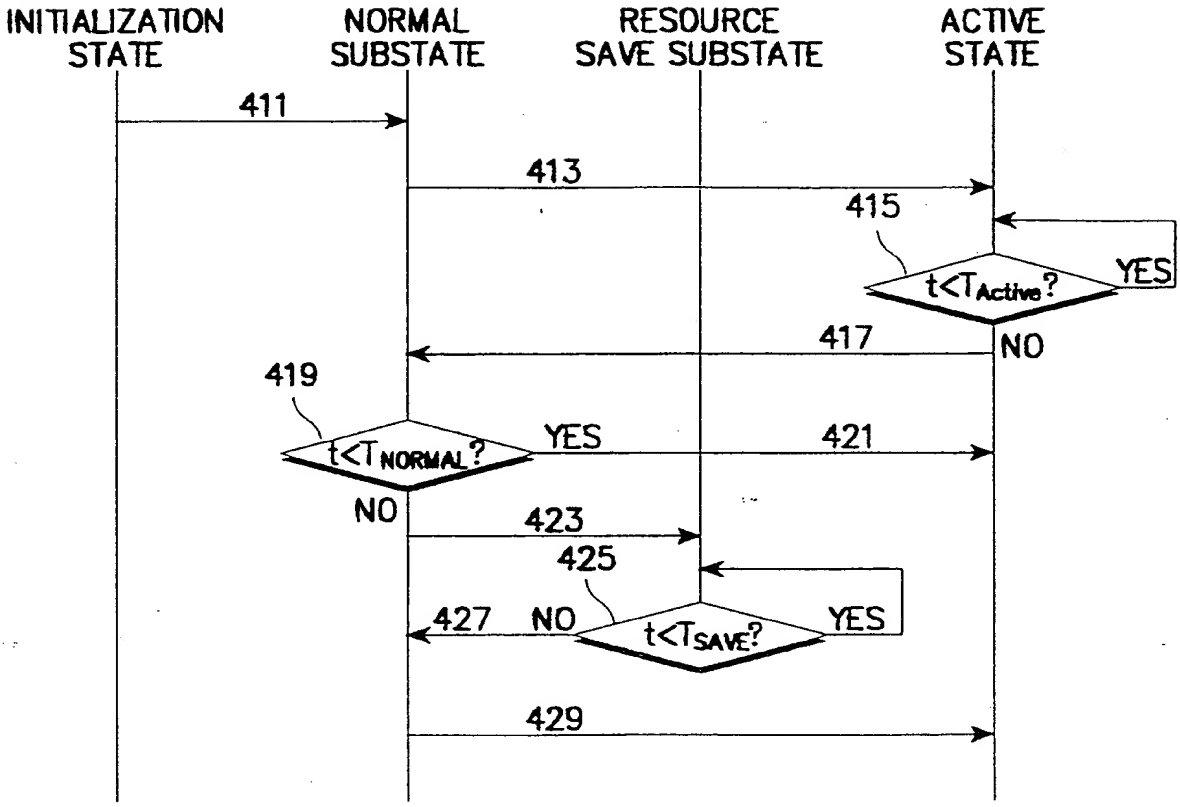
INITIALIZATION STATE
NORMAL SUBSTATE
RESOURCE SAVE SUBSTATE
ACTIVE STATE
411
413
415
t<T Active?
YES
NO
417
419
t<T NORMAL?
YES
421
NO
423
425
427
NO
t<T SAVE?
YES
429

FIG. 4

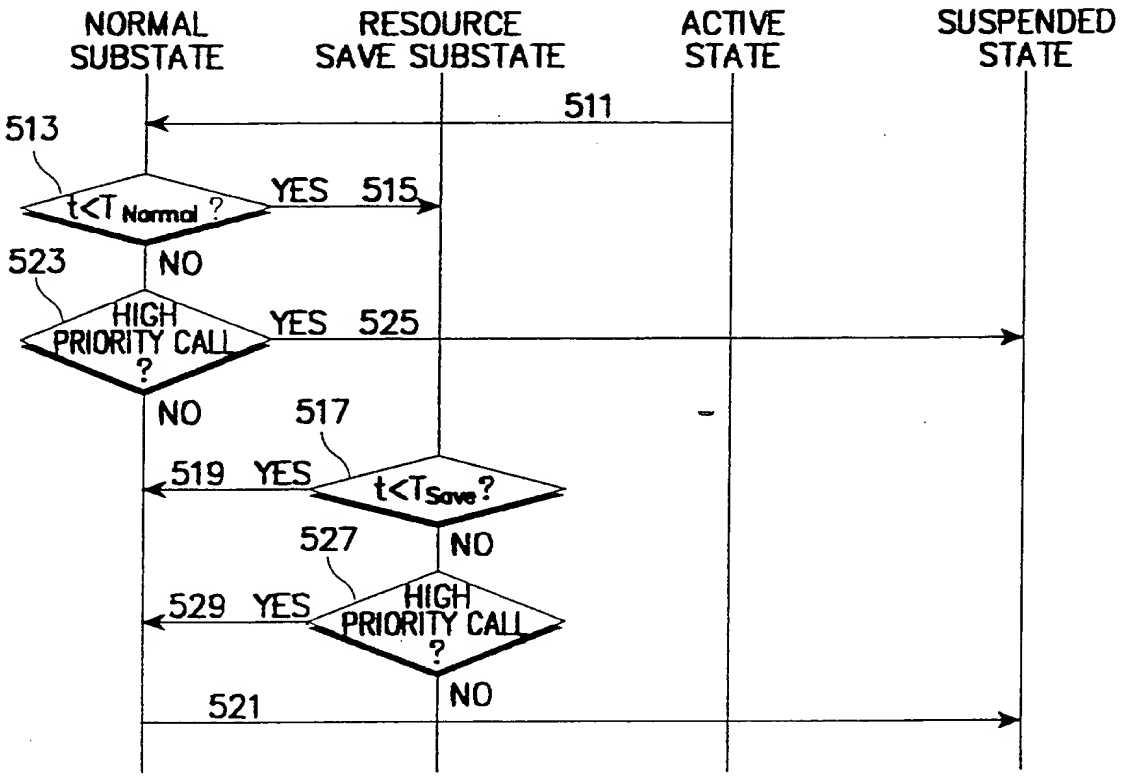
NORMAL SUBSTATE
RESOURCE SAVE SUBSTATE
ACTIVE STATE
SUSPENDED STATE
511
513
t<T Normal ?
YES 515
523
NO
HIGH PRIORITY CALL ?
YES 525
NO
517
519 YES
t<T Save?
527
NO
529 YES
HIGH PRIORITY CALL ?
NO
521

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00040

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: H 04 B 7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[6]: H 04 J 13/02; H 04 B 7/26; H 04 Q 7/22, 7/30, 7/36, 7/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 539 728 A (GAIANI et al.) 23 July 1996 (23.07.96), especially abstract; fig.1,3; claims 1,3.	1
A	WO 97/15 155 A1 (TELEFONAKTIEBOLAGET LM ERICSSON) 24 April 1997 (24.04.97), abstract; fig.8; claims 1-9.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
„E" earlier application or patent but published on or after the international filing date
„L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
„O" document referring to an oral disclosure, use, exhibition or other means
„P" document published prior to the international filing date but later than the priority date claimed
„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 April 1999 (29.04.99)	31 May 1999 (31.05.99)

Name and mailing adress of the ISA/AT	Authorized officer
Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/200	Badics Telephone No. 1/53424/377

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 99/00040

Im Recherchenbericht angeführtes Patentdokument / Patent document cited in search report / Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung / Publication date / Date de publication	Mitglied(er) der Patentfamilie / Patent family member(s) / Membre(s) de la famille de brevets	Datum der Veröffentlichung / Publication date / Date de publication
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		IT A 1261365	20-05-1996
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		GB AO 9808186	17-06-1998
		GB A1 2321166	15-07-1998
		US A 5729531	17-03-1998